

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS—MILTON WHITNEY, Chief.
IN COOPERATION WITH THE NEBRASKA SOIL SURVEY, G. E. CONDRA, DIRECTOR,
UNIVERSITY OF NEBRASKA.

SOIL SURVEY OF WASHINGTON COUNTY, NEBRASKA.

BY

L. VINCENT DAVIS, OF THE U. S. DEPARTMENT OF AGRICUL-
TURE, IN CHARGE, AND H. C. MORTLOCK, OF THE
NEBRASKA SOIL SURVEY.

THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1915.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE
1917.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS,

Washington, D. C., April 4, 1916.

SIR: In the extension of the soil survey in the State of Nebraska during the field season of 1915 a survey was undertaken in Washington County. This work was done in cooperation with the University of Nebraska, and the selection of the area was made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this work and to request their publication as advance sheets of Field Operations of the Bureau of Soils for 1915, as authorized by law.

Respectfully,

MILTON WHITNEY,

Chief of Bureau.

Hon. D. F. HOUSTON,

Secretary of Agriculture.

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SOIL SURVEY OF WASHINGTON COUNTY, NEBRASKA.

By L. VINCENT DAVIS, of the U. S. Department of Agriculture, In Charge,
and H. C. MORTLOCK, of the Nebraska Soil Survey.—Area inspected by
THOMAS D. RICE.

DESCRIPTION OF THE AREA.

Washington County, Nebr., lies in the eastern tier of counties of the State, its southern boundary being 6 miles north of Omaha. It is bounded on the north by Burt County, on the east by the State of Iowa, on the south by Douglas County, and on the west by Dodge County. The Missouri River separates it from the State of Iowa except in one place, where the stream has shifted its course. Washington County comprises an area of 380 square miles, or 243,200 acres.

The county presents a variety of surface features but may be separated broadly into two main topographic divisions—the upland, consisting of a more or less eroded plain, and the alluvial land along the streams, which may be subdivided into terrace and first bottom.

The upland occurs as a broad divide lying between the Missouri and Elkhorn Rivers. It includes the entire area of the county, with the exception of belts of alluvial land along the Missouri and Elkhorn Rivers and narrow flood plains that follow the smaller streams throughout the upland. The topography of the upland is that of a loess-covered plain nearly everywhere eroded by streams. The remnant of the original plain that has escaped erosion is seen in the relatively small flat areas in the highest parts of the divides. These high, flat areas occur throughout much of the upland, but are most numerous in a belt extending through the center of the county parallel to the Missouri River. They are encountered most extensively between Bell and Papillion Creeks. The topography of the eroded portion of the plain varies from gently rolling to sharply rolling in the northern part of the county and from gently rolling to rough and broken in the eastern part. The rougher portions occur on the lower slopes to the Missouri and Elkhorn Rivers. The most eroded area is in the southeastern part of the county along the slopes from the upland to the bottoms, extending northward as far as Desoto. The slopes west of Bell Creek are very gentle, but to the

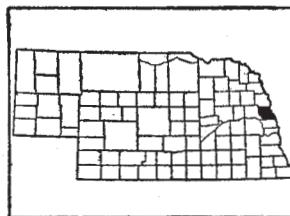


FIG. 1.—Sketch map showing location of the Washington County area, Nebraska.

east they are steeper, and east of Papillion Creek there is an area of rough land where the hill slopes are very abrupt, though no extensive tracts are too rough for cultivation.

The alluvial lands of Washington County consist of the higher terraces, now above the limits of overflow, and the first bottoms, or present river flood plains. The greatest development of the terraces or benches is along the Missouri River, where they in places attain a width of over a mile. The greatest width is at Blair, while the terrace is narrowest from a point about $1\frac{1}{2}$ miles south of Blair to a point 1 mile south of Desoto. The Missouri terrace is also narrow in the extreme southern $1\frac{1}{2}$ miles of its development in the county. In the two narrow stretches mentioned it is in places discontinuous. The Missouri River terrace lies 40 to 100 feet above the first bottoms, its greatest elevation above the latter being in the southeastern part of the county. The surface is in general comparatively flat to undulating, but the development of streams has in some places modified the originally flat surface. The terrace is separated from the bottom lands by a well-defined slope varying in steepness. On the west colluvial accumulations have rounded the angle between it and the bluff slope.

The terrace developments along the Elkhorn River are very small and disconnected. They rise about 30 feet above the first bottoms. The Bell Creek terraces extend intermittently along the stream for a distance of about 10 miles above its mouth. The total area of the isolated strips is comparatively small. The elevation of the terraces above the first bottom varies from about 8 feet where they begin to about 20 feet in the southernmost development in the county.

Along all the better developed watercourses are strips of flat alluvial flood plains or first bottoms, comprising land subject to overflow. The flood plains vary in width in proportion to the size of the watercourse. Collectively, the first bottoms constitute about one-fifth of the total area of the county. The largest area is along the Missouri River. East of Herman, near the north county line, the bottom is $4\frac{1}{2}$ miles wide, and the width diminishes only slightly to a point about 1 mile north of Blair. East of Blair the bottom land is less than a mile in width. Northeast of Desoto it extends about $3\frac{1}{2}$ miles out into a bend of the river, and the width varies from 1 to 3 miles to a point about 1 mile north of the south county line, where the bottom pinches out, the river impinging against the upland.

Scattered through the flood plain of the Missouri River, seldom more than a mile from the stream, are many oxbow lakes, the unfilled remnants of former river channels.

The Elkhorn River first bottom attains a width of about a mile. Its total area in this county is comparatively small. Oxbow lakes are frequently developed along its course, as along the Missouri. Bell

Creek is bordered by a flood plain attaining a width of about one-half mile, while Brown, Papillion, New York, Long, and Mill Creeks have alluvial plains of less extent.

The elevation of Washington County above sea level ranges from about 1,000 feet in the Missouri River bottoms at the south county line to about 1,320 feet in the uplands, the highest elevation probably being in the northwestern part of the county. The general slope of the county is to the southeast.

The Missouri River Valley along Washington County varies in width from 5 to 12 miles. The rate of fall of the Missouri between Tekamah and Blair is 0.85 feet per mile, while the drop between Blair and Omaha is 1 foot per mile. The principal direct tributary of the Missouri River within the county is Fish Creek. The channel of this stream has been dredged and straightened.

Elkhorn River, whose course lies in the county for short distances in several places along the southwest boundary, has a valley ranging in width from three-fourths to 1 mile. Its course in this county is practically all in the Platte River bottoms, which extend north several miles from that stream. The Elkhorn itself drains only a very narrow strip of land in this county. Bell Creek enters the county 4 miles east of the northwest corner and flows into the Elkhorn River just outside the county, southeast of Arlington. It drains a strip of territory 4 to 10 miles wide, and its valley ranges from one-half to five-eighths mile in width.

The range in elevation between the bottom lands and the contiguous uplands along the Missouri River, Elkhorn River, and the lower course of Papillion Creek is 150 to 200 feet. The bottoms along Bell Creek lie about 120 feet below the uplands.

The drainage of the county may be considered as of two divisions, viz, that which flows in a southerly to slightly southeasterly direction, and that which flows in a general easterly direction into the Missouri River. The Missouri drains directly approximately two-fifths of the area of the county. The streams of the first division are more mature and have a lower gradient and broader valleys. The eastward flowing watercourses are mostly wet-weather streams which are young and have not established a uniform grade profile. The high gradient of flow, which is greatly in excess of that of the streams in the Platte River drainage basin, has resulted in the formation of many gulch-like or V-shaped draws and narrow valleys. In some places streams have cut so deeply into what was, till recently, their narrow alluvial flood plain that it is now impossible for them to overflow their banks. The streams in many instances do not issue from the upland in the most direct manner, but parallel the margin for a short distance before entering the Missouri bottoms.

Contributing to the principal watercourses are many small streams, spring branches, and intermittent drainage ways, which divide and subdivide so that the drainage system is most comprehensive. It has encroached upon the plain until only small areas of undissected level land remain.

Washington County is in one of the earliest settled sections of the State. On August 3, 1804, the explorers Lewis and Clark held a council with the Indians near the present site of Fort Calhoun. Settlement did not begin until almost half a century later. In 1847 the Mormons on their way from Nauvoo to Utah settled temporarily in the territory, and a few members of the party probably became permanent settlers. The majority of the settlers came from Iowa and from Missouri, Illinois, Indiana, Ohio, and other more eastern States. According to the census, 82.9 per cent of the inhabitants of the county are native, and more than half of these are of native parentage. Of the foreign nationalities represented, German and Danish are most important.

The population of Washington County, according to the 1910 census, is 12,738. Blair is the county seat and largest town, with a population of 2,584. The remainder of the population, or 79.7 per cent of the total, is classed as rural, and averages 26.7 persons to the square mile. With the exception of a slightly greater density of settlement in the vicinity of Blair, the rural population is evenly distributed. Roughly, 64 per cent of the inhabitants of Washington County are engaged in agricultural pursuits.

Blair is situated close to the Missouri River, about midway between the north and south county lines. Arlington is the town of next importance, with a population of 645. Herman, Fort Calhoun, and Kennard have a population of slightly over 300 each. Desoto and Washington are smaller towns on railroads, while Fontanelle, Orum, and Spiker are local trading centers.

The county is well supplied with transportation facilities. The Omaha-Sioux City branch of the Chicago, St. Paul, Minneapolis & Omaha Railway, traverses the county along the Missouri bottoms. Herman, Blair, Desoto, and Fort Calhoun are situated on this line. The Fremont-Missouri Valley branch of the Chicago & North Western Railway crosses the county in a northeasterly direction, passing through Arlington, Kennard, and Blair. The main line of the Chicago & North Western crosses the southwestern corner of the county, passing through Arlington. The Lincoln-Sioux City branch of the Chicago, Burlington & Quincy Railroad roughly parallels the western boundary of the county 2 to 4 miles beyond the county line. It provides shipping facilities for many farmers in the northwestern part of the county.

The roads of Washington County are kept in good condition. While none are surfaced, there is provision for dragging the most important highways after rains. There are several roads used as automobile routes, the principal one of which is the Sioux City and Omaha road, paralleling more or less closely the eastern margin of the upland. All sections of the county are supplied with rural mail delivery service. Most of the farm homes are provided with telephones. Churches are located in places convenient of access. The schools are in general well constructed and well maintained.

Omaha, located in Douglas County, 6 miles from the south Washington County line, is the principal market for the farm products, with the exception of fruit. There is not a large number of commercial fruit growers, and they ship through associations to Denver, St. Paul, and Minneapolis, and South Dakota points. The live stock is shipped to the stockyards at Omaha.

CLIMATE.

The climate of Washington County is pleasant and healthful. The autumn season in particular is generally pleasant, with "Indian-summer" weather lasting late into the fall. The low temperatures sometimes occurring in winter are not usually destructive to winter-grown crops, owing to the protection of snow, and the climate in general is favorable for the production of all the common farm crops.

There is not sufficient variation in surface characteristics to cause any appreciable differences in climate within the county.

The data in the table below are compiled from the records of the Weather Bureau station at Tekamah, in Burt County, adjoining Washington County on the north, and may be taken as fairly representative of climatic conditions in the latter county. The table gives the normal monthly, seasonal, and annual temperature and precipitation.

*Normal monthly, seasonal, and annual temperature and precipitation at
Tekamah, Burt County.*

| Month. | Temperature. | | | Precipitation. | | | |
|---------------|--------------|-------------------|-------------------|-----------------|-----------------------------------|------------------------------------|------------------------------|
| | Mean. | Absolute maximum. | Absolute minimum. | Mean. | Total amount for the driest year. | Total amount for the wettest year. | Snow, average depth of fall. |
| December..... | °F. 26.4 | °F. 62 | °F. -20 | Inches. 0.92 | Inches. 2.85 | Inches. 0.27 | Inches. 7.3 |
| January..... | 22.3 | 63 | -33 | 0.75 | 1.50 | 0.03 | 5.8 |
| February..... | 22.0 | 78 | -33 | 1.02 | 0.80 | 0.93 | 7.4 |
| Winter..... | 23.6 | 78 | -33 | 2.69 | 5.15 | 1.23 | 20.5 |

Normal monthly, seasonal, and annual temperature and precipitation at Tekamah, Burt County—Continued.

| Month. | Temperature. | | | Precipitation. | | | |
|----------------|--------------|-------------------|-------------------|-----------------|-----------------------------------|------------------------------------|------------------------------|
| | Mean. | Absolute maximum. | Absolute minimum. | Mean. | Total amount for the driest year. | Total amount for the wettest year. | Snow, average depth of fall. |
| March..... | ° F. 36.5 | ° F. 89 | ° F. — 6 | Inches. 1.48 | Inches. 1.23 | Inches. 1.08 | Inches. 6.6 |
| April..... | 51.3 | 94 | 13 | 3.13 | 5.09 | 3.57 | 1.1 |
| May..... | 61.0 | 100 | 23 | 4.44 | 0.61 | 10.97 | 0 |
| Spring..... | 49.6 | 100 | — 6 | 9.05 | 6.93 | 15.62 | 7.7 |
| June..... | 70.0 | 100 | 35 | 6.18 | 4.92 | 3.24 | 0 |
| July..... | 75.0 | 108 | 41 | 4.55 | 0.88 | 7.31 | 0 |
| August..... | 73.0 | 104 | 39 | 3.79 | 3.06 | 12.12 | 0 |
| Summer..... | 72.7 | 108 | 35 | 14.52 | 8.86 | 22.67 | 0 |
| September..... | 65.6 | 104 | 23 | 2.77 | 0.57 | 3.83 | 0 |
| October..... | 53.4 | 93 | 13 | 1.85 | 2.01 | 1.43 | 0.5 |
| November..... | 37.5 | 75 | —15 | 1.12 | 0.32 | 1.83 | 3.3 |
| Fall..... | 52.2 | 104 | —15 | 5.74 | 2.90 | 7.09 | 3.8 |
| Year..... | 49.5 | 108 | —33 | 32.00 | 23.84 | 46.61 | 32.0 |

The mean annual temperature for Washington County is about 49.5° F. February is the coldest month, with a mean temperature of 22° F., while July is the warmest, with a mean of 75° F. There is thus a range of temperature of about 53° between the means of the coldest and warmest months. The lowest temperature recorded is —33° F., and the highest 108° F.

The county lies in the 32-inch precipitation belt. The rainfall is ample for the production of crops and is so distributed throughout the year that crops seldom lack moisture during the growing season if soil moisture is properly conserved. Serious droughts are practically unknown. The records of the Tekamah station show an average occurrence of 80 days a year with 0.01 inch or more precipitation. The records also show the snowfall to average 32 inches annually. Snow may fall in any month from October to April. The snowfall is generally sufficient to afford protection for winter wheat.

The average growing season is 157 days, which is ample for the maturing of the ordinary farm crops. The average date of the last killing frost in the spring is April 27 and that of the first in the fall, October 1. Killing frost has occurred, however, as late in the spring as May 27 and as early in the fall as September 13.

According to the records of the Weather Bureau station at Omaha, the winds during March and April are prevailingly from the north, and during May and June from the southeast. From July through

October they are prevailingly from the south, and from November through February from the northwest. The average wind velocity for the year is 9 miles an hour. The highest average velocity is during March and April and the lowest during July and August. Tornadoes are of rare occurrence, though not entirely unknown.

The records of the Omaha station show the average relative humidity to be about 70 per cent, with comparatively little variation. The average expectation is 170 to 180 clear days a year, and 80 to 90 cloudy, the remainder being partly cloudy.

AGRICULTURE.

Agriculture has been the chief interest of Washington County since the earliest settlement. The first crops consisted of corn, buckwheat, and spring wheat, with potatoes and other vegetables produced for home use. Buckwheat was grown in a small way until 1875, when its production was practically discontinued. Until about 15 years ago flax was grown, but the crop gradually came to be considered unprofitable and has been abandoned. About 1865 the wheat acreage was increased considerably and for a period of years following spring wheat made excellent yields, 30 bushels per acre often being obtained. About 1907 winter wheat was introduced generally and its acreage has increased each year at the expense of the area sowed to spring wheat. Cattle and hogs were an important source of income during the late sixties and early seventies.

According to the census, in the year 1879 there were 50,858 acres in corn, producing 2,326,329 bushels; 26,514 acres in wheat, producing 319,969 bushels; 8,329 acres in oats, with a production of 259,416 bushels; and 1,120 acres in rye, producing 19,754 bushels. Barley and buckwheat were grown on a small acreage and 17,857 acres were cut over for hay, with a production of 31,802 tons. In addition to these crops, beans, flax, Irish potatoes, sweet potatoes, tobacco, broom corn, and sorghum were grown, though inextensively, together with orchard products, to the value of about \$2,800. The censuses of 1890 and 1900 show a steady increase in acreage for both corn and oats. Wheat decreased in acreage from 1880 to 1890, but by 1900 this crop occupied 33,689 acres. Hay and barley each occupied a larger acreage in 1889 than in either 1879 or 1899. In 1899 the value of orchard and small-fruit products reached about \$48,000; the value of animals sold or slaughtered amounted to \$772,072; dairy products were sold to the value of \$84,067; and poultry brought \$51,481.

The agriculture of Washington County has developed from grain growing combined with cattle raising to the general production of grain both for the market and for feeding hogs, cattle, and other live stock. The present agriculture may be summed up as the produc-

tion of corn, oats, hay, wheat, barley, and potatoes for sale, for stock feeding, and for home consumption, together with dairy farming, cattle and hog raising, and fruit growing. Specialized farming is carried on by several small groups of farmers. Some farmers grow sweet corn for canning or alfalfa for milling.

The general farm crops comprise corn, oats, hay, wheat, barley, and potatoes. Corn is by far the most important crop, occupying an acreage practically as large as that of all the remaining crops combined. According to the census, corn was planted on 74,457 acres in 1909, with a production of 2,891,553 bushels, or 38.8 bushels per acre. There is probably no farm in the county that does not produce some corn. The greater part of the crop is fed on the farm to hogs, beef cattle, work stock, and dairy animals. A considerable quantity of corn is grown for ensilage. Probably less than 6 per cent of the production is sold outside the county.¹ The corn is not always of distinct varieties, much of it being mixed. Yellow corn seems to be more popular than white. Reids Yellow Dent is the leading variety, with Early Rose and Legal Tender of less importance.

The crop of next importance is oats. In 1909 oats occupied 36,756 acres, giving a production of 955,686 bushels, or 26 bushels per acre. Only a very small proportion of the crop is sold, most of it being fed on the farms to work stock and other animals. In some cases oats and barley are sown together and the crop thrashed for feed. The most common varieties of oats grown are the Kherson and the Russian Green.

Hay ranks third among the crops from the standpoint of acreage. In 1909 hay to the amount of 54,036 tons was cut from 26,740 acres. This production includes wild hay and that made from cultivated grasses. Wild hay was cut from 11,148 acres and yielded about $1\frac{3}{4}$ tons per acre. Timothy and clover mixed had the next largest acreage, occupying 6,162 acres and producing 10,561 tons of hay, or about $1\frac{3}{8}$ tons per acre, in 1909. Alfalfa, a hay crop of particular importance, was cut for hay on 5,667 acres in 1909 and yielded on an average about 3 tons per acre. Timothy alone was cut from 2,016 acres, yielding about $1\frac{1}{2}$ tons per acre, and clover alone from 1,093 acres, yielding about 2 tons per acre. By far the greater part of the hay produced is fed to beef and dairy cattle, work stock, and sheep. Only a very small proportion of the crop is exported.

Wheat is the principal money crop. This grain was sowed on 16,172 acres in 1909. The production amounted to 284,419 bushels, about 17.6 bushels per acre. The proportion of winter wheat to spring wheat grown is more than 4 to 1. The most commonly grown variety of winter wheat is Turkey Red. A small quantity

¹ Bul. 27, State Bureau of Labor and Statistics, Lincoln, Nebr., pp. 25 and 37.

of wheat is consumed locally, but most of the production is sold. Elevators are operated at every town located on a railroad. There is a flour mill at Blair which disposes of a small proportion of the wheat produced in the county.

The fifth crop in point of acreage is barley. This grain occupied 1,527 acres in 1909 and yielded on an average 21.6 bushels per acre. Almost the entire production of barley is fed to horses, hogs, and cattle, very little being sold.

Potatoes are a rather important crop. The production in 1909 was over 104,000 bushels and the yield for the county averaged about 80 bushels per acre. Potatoes are grown as one of the chief sustenance crops on the farm. Nearly the entire production is used within the county. Farmers having a surplus dispose of it in the small towns.

Fruit is grown to a small extent on practically every farm. The fruit produced includes tree fruits, bush fruits, and berries. That part of the production not used on the farm is marketed, but there is generally only a small surplus for sale. On a few farms in the vicinity of Coffman and Fort Calhoun and to a lesser extent in the vicinity of Arlington there are commercial orchards. Apples are the chief crop. Many summer and winter varieties are grown. About 70 carloads of apples are shipped annually from Blair, about 40 to 50 carloads from Arlington, and a considerable quantity from Fort Calhoun. Grapes are the fruit crop next in importance. Grapes are grown chiefly in the region of rougher topography in the southeastern part of the county. The principal varieties grown are Moore Early, Concord, and Worden. From 15,000 to 18,000 8-pound baskets are shipped from Blair annually. The small fruits, including strawberries, blackberries, dewberries, raspberries, and loganberries, are minor crops. Strawberries are a profitable crop. By rotating with alfalfa—the latter remaining for three years—disease is avoided and the white grub, the greatest pest of the crop, is kept under better control.

Some of the fruit growers belong to associations, but others, especially in the vicinity of Blair and Fort Calhoun, market their crop individually. Practically all the fruit is shipped to northern and western points. A cider and vinegar factory at Blair consumes a large proportion of the apple production of the county. When scarce, apples are shipped in from outside points.

A cannery located at Blair handles several vegetables, but specializes in sweet corn. It has a capacity of about 2,000 tons a year. The varieties of sweet corn grown for canning are the Hitchcock and Evergreen. The factory contracts in the spring for the acreage to be planted and furnishes the seed, which the farmer pays for when

he delivers the crop. The farmer receives a stipulated price per ton for corn delivered in the husk. The husks, cull corn, and cobs are put into a silo and sold to cattle and sheep feeders. The vinegar factory at Blair also cans tomatoes, beans, and apples. The canned products of the county are shipped to Omaha and various places throughout the State.

An alfalfa mill at Fort Calhoun handles about 18,000 tons of hay annually. About 2,000 tons are obtained locally and the remainder is shipped in. Prices paid range from \$9.50 to \$12 a ton delivered. The mill puts out feed of several grades—especially desirable for dairy cattle. The product sells on the retail market at \$1.25 to \$1.50 per hundredweight. The output is shipped to States east of the Missouri River, the bulk going to the New England States.

Hog raising is probably the foremost animal industry in Washington County. According to the census, 45,150 hogs were sold or slaughtered in 1909, an average of 27 animals to the farm. Almost every farm in the county raises hogs in greater or less number. It is a common practice to feed hogs on corn and tankage. The Duroc Jersey and Poland China breeds predominate, with the former in the lead. Some Hampshire, Berkshire, and Chester White animals are raised. Most of the stock is not registered. After provision is made for supplying home needs, hogs are shipped to the Omaha stockyards.

More than 6,000 sheep are sold or slaughtered in the county annually. Only a small percentage of the farmers raise sheep. A majority of the animals fattened are shipped in from Omaha. Beyond a small number slaughtered to supply the household needs, the sheep are shipped back to the Omaha markets.

A large number of farmers handle cattle. The Shorthorn is the principal breed, with Hereford and Red Poll represented to a small extent. There are only a few purebred herds. Breeders mainly sell breeding animals and dispose of the remainder as beef. About one farmer in ten feeds cattle. Although some beef cattle are raised on the farms, the majority are feeders shipped in from Omaha. The cattle, when fattened, are in most cases shipped directly to the Omaha stockyards. Nearly every farmer sells annually a few head of cattle either to cattle feeders or to buyers who dispose of them locally or ship to Omaha. The usual feeding period is five to eight months. Feeders are usually bought in September and sold in April. They are usually fed in the open air in the winter, together with hogs, and are fed corn and oil meal or cottonseed meal, with alfalfa or silage as roughage. It is a common practice to pasture corn land with cattle and horses. Cattle feeding is said to be declining, owing to a lessened margin of profit in recent years. According to the cen-

sus, 1,735 calves and 1,958 other cattle were sold or slaughtered in 1909.

The annual production of dairy products in Washington County, excluding those used in the home, amounts to slightly less than one-quarter million dollars in value. Although some milk and butter are sold in Blair by farmers in the vicinity, the bulk of the dairy products disposed of consists of cream. Nearly every farmer has a separator and the cream is either hauled to the creamery at Fontanelle or the ice-cream factory at Blair, or is shipped to Fremont or Omaha, more often the latter. Active dairying is largely confined to the warmer months. The principal breeds of cattle on the dairy farms are Jersey, Shorthorn, and Swiss, although many cows of the types commonly recognized as beef breeds are milked. There are usually only 3 or 4 cows on a farm, but sometimes as many as 8 or 10. The 1910 census gives the number of dairy cows on farms reporting dairy products as 8,459.

Horse raising is for the most part confined to the breeding of the work mares. The Percheron breed is most popular, though a few Belgians are kept. Most of the stallions are purebred, while a majority of the mares are grades. Though but few mules are raised at present, their number is increasing and about one-third of the mares are bred to jacks.

Poultry and eggs amounting in value to about \$225,000 annually are produced on the farms. None of the farmers specialize in poultry raising.

The adaptation of certain soils to particular crops is recognized by the farmers to some extent. They recognize that the Knox silt loam with its steeper slopes and consequent more thorough air drainage is better suited to orcharding and trucking than are the other upland soils or any of the bottom-land types, and that the Wabash and Cass soils are richer and better suited for corn than the other types, but that they are not adapted to wheat until they have been planted to corn for 15 to 20 years, as otherwise the growth is too rank and lodging likely to occur. Oats for a similar reason are grown on the Wabash and Cass soils only to a very small extent, and then only the Kherson oats, a short-strawed variety. The Sarpy very fine sandy loam is recognized as being well suited to strawberries, onions, and watermelons. The upland Marshall silt loam is commonly recognized as being an especially good soil for corn.

The work stock consists of medium to heavy draft horses and mules. A few power tractors are used for plowing in the bottoms and on the more level upland, and these machines are coming into more general use. Where corn is listed, listers and 2-row lister cultivators are part of the farm equipment, and where the corn is

checked, a checkrower and ordinary 2-horse cultivator are used. Of the cultivators 95 per cent are of the shovel type, generally with six shovels. Riding cultivators are the prevailing type. Drills have a grass-seeding attachment, and 95 per cent of them are disk drills. Rollers have not been generally used but are becoming more common. Of the plows used about 80 per cent are gang plows. Four and occasionally five horses are used with gang plows, three or four with the sulky plow, and two or three with the walking plow. Very few disk plows are used. Most farms have manure spreaders, mowers, rakes, binders, and disk harrows, while a few have in addition corn binders and hay balers.

Land to be put in corn is generally plowed in the spring to a depth of 6 to 8 inches, and is disked and harrowed two or more times before planting. The greater part of the corn planted is checked, only about one-sixth of it being listed. The crop is cultivated three to five times. When corn succeeds itself, if the previous year's crop has not been cut for fodder or silage, the stalks are broken down and cut up, either with a stalk cutter or by dragging a rail across the field, a disk being used later. When oats follow corn, the land is generally disked once; the oats are broadcasted and the land is disked again and harrowed. Some farmers prefer to drill oats. The crop does better if the land is not plowed in the spring. Winter wheat or spring wheat generally follows oats and the land is usually plowed to a depth of 4 to 6 inches, then disked and harrowed. Wheat is generally drilled in. Clover and timothy are sometimes seeded alone, but more frequently are sown with one of the small grains, usually winter wheat, as a nurse crop. When clover and timothy are to be grown together, the timothy is sown with the wheat and the clover the following spring. The crop is ordinarily pastured the first year and either pastured or cut for hay in subsequent seasons. After the second year the clover practically dies out. The land is then generally put in corn, followed by timothy or clover.

Cornfields are in some cases grazed down by hogs. Some corn is cut for silage and some for fodder. Cutting is done either by hand or with corn binders. Over a considerable proportion of the acreage planted the corn ears are snapped and the stalks pastured. The small grains are cut with a binder and shocked. In some instances the sheaves are stacked. The grain is thrashed in the late summer or fall, several thrashing outfits serving the farmers. Hay is either stacked or stored in barns. Some hay is baled.

While no definite system of rotating crops is followed in this county, the following general rotation, with more or less variation, is practiced by a majority of the farmers: Corn 2 to 4 years, oats 1 year, winter wheat 2 years (or spring wheat 1 year and winter

wheat 1 year), and clover or timothy and clover 2 years, followed by corn.

Practically no commercial fertilizer is used, but all the barnyard manure is used on the fields, generally being broadcasted on land to be plowed for corn.

Farm labor in Washington County is usually hired for the period from March 1 to the close of the corn-husking season, which usually begins the middle of October. A few laborers are hired by the year or for an indefinite period. Monthly wages range from \$25 to \$35, with room, board, and usually washing. Hands hired by the day generally receive \$2 a day. Corn shuckers are paid at the rate of 4 cents a bushel. The farm labor is all white. The 1910 census records an average expenditure for labor in 1909 of \$306.68 per farm on the 880 farms reporting outlay.

The size of farms ranges from 25 to more than 600 acres. Most of the farms contain between 80 and 320 acres. The 1910 census gives the average size of farms as 147.2 acres, a decrease of 15.8 acres since 1880. The total number of farms is reported as 1,629.

The percentage of farms operated by owners is 56.1, by tenants 42.6, and by managers 1.3. Since 1880, when 73 per cent were operated by owners and 27 per cent by tenants, the percentage of farms operated by owners has steadily decreased. Farm leases generally cover only one year. About one-half of the farms tenanted are rented for cash and the remainder on a share basis. Cash rent varies from \$4 to \$6 an acre. Under share-rent contracts the tenant receives two-fifths to one-half the crop and usually furnishes all equipment, labor, and outlay, although in a few cases the owner furnishes all or part of the seed and equipment.

The 1910 census reports 98.6 per cent of the area of Washington County as being in farms, and 91 per cent of the land in farms as being improved. Land values vary according to proximity to town, railroad, and school, and depend also upon the condition of the land, its topography, and the extent and state of preservation of the improvements. Land values range from \$40 to \$200 an acre. The average for the whole county is probably about \$150 an acre. The lowest priced land is apparently that bordering the Missouri River, which is likely to suffer destructive erosion with the meandering of the river. The highest priced farm land is in the flat uplands in the central and northwestern parts of the county.

The farm buildings in the county, including the dwellings, are well built and well cared for. Many of the barns have stone or concrete foundations. The fences are good, a large percentage being of woven wire. Either windmills or gasoline engines are employed

for the pumping of water. About one-tenth of the farmers have silos, and this equipment is beginning to be considered indispensable.

SOILS.

The soils of Washington County may be divided into three groups, namely, glacial, loessial, and alluvial. All are derived entirely from transported materials. In order to understand the derivation of the soils it is necessary to consider briefly the physiographic structure of the region.¹

The bedrock materials of the county, underlying the mantle rock, consist of Carboniferous limestones and shales in the southeastern part, overlain throughout the remainder of the county by a Cretaceous formation known as the Dakota sandstone. The bedrock formations are distinctly stratified and lie in nearly horizontal positions. They have no influence upon the character of the soils and only a little upon the water supply.

The greater part of the upland is covered by drift deposited by two or more advances of glaciers coming from the north. This drift is composed of three sheets or layers. The lowermost, consisting of bluish clay interspersed with pebbles and some boulders, known as the Nebraskan, does not give rise to any distinct soils. Lying upon this, but probably not throughout all the upland, is a fairly well defined layer of sand and gravel known as the Aftonian drift. This is of some economic importance in supplying well and spring water, but has not influenced the surface soil. The upper drift sheet is known as the Kansan.

The surface of the upland in most places is mantled with loess, which constitutes the most extensive and important soil-forming material in the county. It is thickest on the small upland plains and thins out on the hillsides toward the valley floors. Its maximum thickness where it has not been eroded is about 100 feet. Formerly this plains loess extended over the entire county. It is the opinion of the geologists of the Nebraska Soil Survey that the material was carried to its position by sluggish streams during one or more of the later glacial advances into Minnesota, Iowa, and South Dakota, the material consisting of fine glacial outwash mixed to some extent with materials deposited by streams coming from the northwest.

None of the layers below the Kansan drift are exposed in this county. The Kansan drift itself consists of a bluish or bluish-gray to brown clay, with numerous boulders and fragments of limestone, sandstone, quartz, and chert. It is sometimes referred to as "blue clay" or "hardpan." It has a depth of about 100 feet in this county. The area of exposure of the Kansan drift is comparatively small.

¹ G. E. Condra, Annual Report, Nebraska State Board of Agriculture, 1914, pp. 262-283.

It appears in more or less disconnected strips or patches along New York Creek and its tributaries and along the small streams north of New York Creek. Weathering of this material has given rise to one series, the Shelby.

The Shelby series is characterized by yellowish-gray to dark-brown surface soils. The subsoils are yellow, reddish-yellow or light-brown, tenacious sandy clays. Fragments of limestone, sandstone, quartz, and chert, as well as iron concretions and streaks of calcareous material are frequently found throughout the 3-foot section. The subsoil is much heavier than the surface soil, the latter being influenced to a considerable extent by the former loessial covering. The soils occupy steep stream slopes and narrow divides and are well drained. One type, the Shelby silt loam, is mapped in Washington County.

Of the loess overlying the Kansan drift there are two phases recognized, plains loess and river loess. During the course of development of the loess deposit there has been more or less modification of the surface by wind action. In places material has been blown to the terraces and bluffs from the valley floor, making a thin veneer of wind-blown loess, but in most places the material of such origin has been removed by surface run-off as fast as it has accumulated. The loess along the bluff that has been subject to modification in this way is termed river loess.

There is little difference between the plains loess and the river loess, except that the former has possibly a slightly heavier texture. Loess is composed very largely of yellowish-brown or buff silt, with a very small percentage of very fine sand and a small percentage of clay. It contains large numbers of lime concretions. The loess was laid down upon the more or less level surface of the Kansan drift, and the surface of the deposit was probably originally flat or nearly so. Run-off and stream action have resulted in very rapid erosion of the loess, and although it characteristically stands almost vertically in cuts, it readily crumbles and caves in under the action of running water and forms steep-sided, V-shaped draws. The higher the gradient of the streams the deeper are the draws and the more severe the erosion. The depth of the loess in this county varies from zero, where the Kansan drift has been exposed by erosion, to 100 feet in the eastern part of the county and more than 160 feet in the northwestern part. The loess has given rise to two soil series in this county, the Knox and the Marshall.

The Knox series includes types having a yellowish or buff color in both surface soil and subsoil. The loess from which they are derived forms the subsoil as well as the surface soil. The underlying glacial till is sufficiently far beneath the surface to have no appreciable effect upon the general character of the soil. Lime concretions are

frequently found in the 3-foot soil section. The topography is undulating to rolling or broken, and the surface is generally well drained. In this county one type of the Knox series, the silt loam, is mapped.

The Marshall series includes the darker colored upland loessial soils in the Central West. There is practically no difference in subsoil between the Knox and the Marshall series, except that the subsoil of the latter may be a trifle heavier. The Marshall series is distinguished from the Knox by its darker surface soil. The topography varies from level to rolling. Surface drainage is good, though in the more level developments of the series artificial drainage is necessary for the best results in farming. The Marshall silt loam, with a flat phase, is mapped in Washington County.

The alluvial or stream-deposited material in this county falls into two divisions—terraces, sometimes called benches or second bottoms, and first bottoms, or flood plains. The terraces lie above the limits of present overflow, while the first bottoms are generally subject to inundations.

The original loess plain was eroded by various streams and their tributaries, carving valleys as large as, or larger than, those existing at the present time. Subsequently these valleys were filled with sediment by the principal streams to the level represented by the highest terraces. The last deposit made by the streams in this sluggish state was silt, which now remains capping these terraces, with sand below. The loess on the terraces is known to the Nebraska Soil Survey by the term "valley loess." It is similar to, if not identical with, the material on the adjacent uplands. It has the same textural composition, color, lime-concretion content, and vertical structure. Its depth is variable and proportionate to the height of the terrace, the greatest depth of the deposit in this county being about 100 feet. The soil derived from this material by the process of weathering and by the accumulation and incorporation of organic matter is classed in the Waukesha series.

The Waukesha series is characterized by dark-brown to black surface soils, underlain by yellow subsoils in which fine gravel is usually present. The subsoil is little or not at all heavier in texture than the surface soil. The Waukesha soils occur in the areas of drift in the Central and Lake States. They are derived from water-assorted glacial débris deposited in broad filled-in valleys or as outwash plains and terraces. The topography is level to undulating. Surface drainage is usually good, although in places artificial measures are necessary. Of this series only one type, the Waukesha silt loam, is mapped in Washington County.

The soil materials comprising the first bottoms are all water laid, having been deposited by the adjoining watercourses. The material varies in texture from sand to clay and in color from light brown or

gray to black. In some places the material is loose structured and friable, while in other places it is close in structure and tenacious. Frequently the alluvium contains considerable organic matter.

The present first bottoms were formed by the entrenchment of the streams below the terrace level and subsequent deposition of sediment during floods. The alluvium of the Missouri River has a known depth of 90 to 100 feet in places. The alluvium of the Elkhorn River and of the other larger streams is quite deep.

The composition of the material varies according to the soils and formations drained by the stream from which the latter derived the sediment. The material laid down by the larger streams rising a considerable distance outside the county is mixed and complex. That along the smaller streams and along those rising within the county is from loessial and glacial soils. Generally when the source of the stream is such that it carries sediment of a variety of textures, the coarser or lighter textured material is found near the watercourse and the heavier farther back, owing to the coarser particles being more quickly deposited than the finer material, which is deposited in still water. In places, however, heavy material is found near the stream, the result of a comparatively recent change in the channel. The same cause sometimes results in a light-textured layer overlying heavy-textured material. Strata of widely varying textures may thus overlie one another, dependent on the course of the stream during the time of deposition.

With weathering, the incorporation of organic matter, and aeration there are derived soils varying almost as much in color and texture as the materials from which they are derived. The soils in this county derived from alluvial material are classed in the Sarpy, Cass, and Wabash series.

The surface soils of the Sarpy series range from light gray to brown in color. They are underlain by loose, silty to sandy subsoils, which are as light textured as, or lighter than, the surface soils. These types occur in the bottoms along the Missouri and Mississippi Rivers and their larger tributaries. Owing to the character of the subsoil, they have good subsurface drainage. Of this series two types are mapped in this survey, the very fine sandy loam and the silt loam.

The Cass series includes those types having dark-brown to black surface soils and sandy subsoils, generally brown in color. The series is distinguished from the Sarpy by its darker colored surface soils and from the Wabash series by its light-textured subsoils. These soils have the same origin as the Sarpy and Wabash types, occur in general in the same bottoms, and are usually well drained. Of the Cass series four types are mapped in this county, the very fine sandy loam, silt loam, silty clay loam, and clay.

The Wabash series is characterized by surface soils of dark-brown to black color and high organic-matter content, with gray or slightly lighter drab subsoils. Like the Sarpy and Cass, the series is derived principally from the loessial and associated soils of the region. The Wabash soils are fairly well drained, though the heavier types need artificial drainage for the best results. Three types are mapped in this survey, the silt loam, silty clay loam, and clay.

The miscellaneous type, Riverwash, consists of intricately mixed alluvium occurring as river bars and levees along the Missouri River. It is nonagricultural.

The individual soil types are described in detail in subsequent pages of this report. In the following table are given the name and the actual and relative extent of each type mapped:

Areas of different soils.

| Soil. | Acres. | Per cent. | Soil. | Acres. | Per cent. |
|---------------------------------|---------|-----------|--------------------------------|---------|-----------|
| Marshall silt loam..... | 147,008 | | Riverwash..... | 3,968 | 1.6 |
| Flat phase..... | 7,424 | 63.5 | Cass silty clay loam..... | 2,688 | 1.1 |
| Wabash silt loam..... | 22,656 | 9.3 | Cass clay..... | 1,984 | .8 |
| Wabash clay..... | 13,056 | 5.4 | Cass silt loam..... | 1,792 | .7 |
| Knox silt loam..... | 12,608 | 5.2 | Cass very fine sandy loam..... | 1,344 | .6 |
| Waukesha silt loam..... | 9,920 | 4.1 | Sarpy silt loam..... | 960 | .4 |
| Wabash silty clay loam..... | 7,168 | 3.0 | | | |
| Sarpy very fine sandy loam..... | 6,400 | 2.6 | Total..... | 243,200 | |
| Shelby silt loam..... | 4,224 | 1.7 | | | |

SHELBY SILT LOAM.

The surface soil of the Shelby silt loam, to a depth of 6 to 12 inches, is a dark-brown to black silt loam, often containing a relatively high percentage of fine sand and in some areas, too small to be mapped separately, having the texture of a loam. The subsoil is a yellowish-brown or gray silty clay loam to clay loam, generally compact and plastic, but frequently containing sand and masses of lime concretions. Small boulders are sometimes found on the type and pebbles of sandstone, limestone, quartz, and chert appear in many places on the surface and throughout the 3-foot soil section. Except for the content of pebbles and grit, the soil profile is in many instances similar to that of the Marshall silt loam.

The Shelby silt loam is derived by weathering from the Kansan drift, where it is exposed on eroded slopes below the loess deposits. In many places the surface soil is composed to some extent either of loessial material that has not been entirely washed away from above the drift or of loessial material that has since been washed down from higher slopes.

This type occurs in small areas and strips, principally in the eastern part of the upland in the northern part of the county. Its greatest development is along New York Creek, south and southwest of Herman. It occupies a position on rather steep slopes and low points of hills, generally surrounded by the Knox or Marshall silt loam and the Wabash silt loam. The type may be said to have a rolling topography. The surface drainage is thorough or even excessive, though the formation of gullies can be checked by the use of careful methods.

The Shelby silt loam is the least important upland soil type in the county. Its total area is only 6.6 square miles. There is a greater proportion of this type in pasture than in the case of the Marshall silt loam. Practically none of the land, however, is forested, with the exception of small areas in woodlots.

About 70 per cent of the area of the Shelby silt loam is in cultivation. The same crops are grown as on the Marshall silt loam. Corn, oats, wheat, barley, alfalfa, clover, and timothy do well. Corn yields 25 to 40 bushels per acre, oats 35 to 45 bushels, wheat 12 to 18 bushels, and alfalfa about 3 tons of hay.¹

The methods of handling the Shelby silt loam are the same as those employed on the Marshall silt loam. The soil is naturally highly productive, but it is slightly less drought resistant than the Marshall. Manure is applied as on the other upland soils.

The Shelby silt loam does not cover any one farm to the exclusion of other soils. Land of the type ranges in value from \$80 to \$150 an acre, averaging about \$100 an acre.²

To improve land of the Shelby silt loam it is necessary that care be taken on the steeper slopes to prevent surface erosion and gullying. The steeper slopes should remain in sod as much of the time as practicable. On the cultivated areas deep plowing and the heavy application of manure are beneficial.

KNOX SILT LOAM.

The Knox silt loam, to a depth of 8 to 12 inches, consists of a brown to yellowish-brown, mellow, friable silt loam. The surface soil varies somewhat in color, being lighter on the steeper and more eroded slopes and on the narrow ridges and sharply dissected upland, and darker in the more nearly flat areas and on the lower slopes. The subsoil is a lighter yellowish brown, loose, open, friable

¹ Statements as to crop yields made in this report are based on figures reported by the farmers, on statistics of yields published in crop reports of the State Board of Agriculture, and on observations of the appearance of crops in the field during the progress of the soil-survey work.

² Statements as to land values given for this and other types are based largely on farmers' reports of actual sales.

silt loam which becomes lighter colored and more yellowish with depth. It is often mottled with gray and may show faint iron stains. Lime concretions are frequently encountered in the lower subsoil and occasionally on the surface. The underlying Kansan drift lies far enough beneath the surface to have had no important influence on the soil.

The Knox silt loam has its greatest development along the border of the upland contiguous to the Missouri River Valley, where it occurs in discontinuous areas in a very irregular strip averaging 3 to 4 miles in width. It also occurs in small areas in the uplands adjacent to the Elkhorn River Valley and in a few small, isolated areas elsewhere in the county.

The topography is in general rolling to broken. The part of the type having rough or broken topography is limited to the vicinity of Coffman. The type is everywhere well drained and in many places the gradient of the streamlets is so high that many draws have been formed, which interfere with cultivation. There is serious washing of the soil in places. Under careful methods, however, erosion and harmful dissection of the land can be largely prevented.

The Knox silt loam is an important soil in the county, covering an area of 19.7 square miles. Only a small part of the type is forested, the timber consisting of blackjack oak, scrub oak, black oak, hickory, and elm. The forested areas have no agricultural value at present except as woods pasture. Of the total area of the type about 60 per cent is in cultivation, and that portion of the remainder not timbered is devoted to pasture. There is much more land used for pasture on this type than on the Marshall silt loam.

The principal crops produced on this type are corn and alfalfa. Wheat and oats are also grown to some extent, though oats do not do very well. Corn is the main crop at present, but tendencies indicate that alfalfa will soon supersede it, as the legume does well and is advantageous in that it keeps the soil from washing. Some of the land has been in alfalfa for 15 years and still supports a good stand. Commercial orcharding, consisting of the production of apples, pears, cherries, grapes, strawberries, and other small fruits, is engaged in by several farmers. Cooperative marketing has made fruit growing profitable, and new orchards and vineyards are being established. The areas of the type farther to the east have the best air drainage for orcharding.

The main live-stock activity on the farms is the raising of hogs and cattle. A few farmers engage in cattle feeding, sheep feeding, and dairying.

Corn yields on this type average 25 to 30 bushels per acre. In the lower lying places of darker colored soil the crop frequently yields

as much as 40 to 50 bushels per acre, while on the eroded spots corn frequently turns yellow and makes very poor yields. The yield of wheat averages between 15 and 20 bushels per acre. Alfalfa affords three cuttings a season and occasionally four, the total yields averaging $2\frac{1}{2}$ or 3 tons per acre.

The Knox silt loam is very similar to the Marshall silt loam in texture and structure. Its topography is such that it is necessary to guard constantly against soil washing and the formation of draws. It is also in many instances necessary to use smaller tillage implements than on the Marshall soil. Few farmers on the Knox silt loam practice a crop rotation. Those who do generally grow corn 3 to 5 years, oats 1 year, and wheat 2 years, returning then to corn.

Only a very few farmers use commercial fertilizer. Barnyard manure is applied as available, preference being given to those areas having the lighter colored and shallower surface soil. In these places the type contains much less organic matter than in the areas of darker soil, which usually occur on slopes and where there has been accumulation of soil material by wash. In such situations, as well as in pastures where live stock is kept, the organic-matter supply and the productiveness are greater.

Land of this type is valued at \$60 to \$120 an acre, the price depending on the topography and improvements. Some of the land close to Blair has a greater value. The average price is probably between \$80 and \$100 an acre.

Places subject to erosion can be protected to a greater or less extent against wash by being plowed along contour lines and to a greater depth, and by being kept in a perennial crop as long as possible. Plowing under vegetation and applying manure are also beneficial.

MARSHALL SILT LOAM.

The surface soil of the Marshall silt loam is a dark-brown to black, friable silt loam, containing a high percentage of silt and extending to a depth of about 15 inches. In a few small areas in the vicinity of Kennard the surface soil is slightly lighter in texture than is typical. The subsoil is a brown, compact, heavy silt loam, passing immediately into a yellowish-gray, heavy silt loam to silty clay loam. At 24 to 30 inches the subsoil becomes lighter texturally and assumes a yellowish-brown or buff color, with faint gray, bluish-gray, and rusty-brown mottlings. Iron concretions are found occasionally in the 3-foot soil section, and lime concretions frequently occur below the depth of 3 feet. The underlying glacial drift is in most places buried 100 feet or more, and has no appreciable influence on the soil.

The Marshall silt loam is the most extensive soil type in the county. It is found in large, continuous areas over most of the upland, especially in the central and western parts. The topog-

rathy is gently rolling to rolling. The more rolling topography is developed mainly east of Bell Creek. West of Bell Creek the topography is very gently rolling to undulating. Surface drainage is sufficient in all areas of this type. On the steeper slopes and along small streams of high gradient erosion is sometimes quite severe, but in general the soil does not wash seriously.

The Marshall silt loam is the most important soil type, agriculturally, in the county. Probably 95 per cent of its total area is in cultivation or is devoted to pasture, the remainder being used for small woodlots or farm buildings, with a small area in timber near the Elkhorn River in the southwestern part of the county. The type is naturally a prairie soil, only a fringe growth of scrub oak and blackjack oak having encroached upon it from the Knox soil in the region of rougher topography bordering the latter type.

The principal crops grown on the Marshall silt loam are corn, wheat, oats, and alfalfa, ranking in acreage in the order named. The wheat grown is practically all of the winter varieties. Clover and timothy are grown rather inextensively, having been in large measure displaced by alfalfa. An objection, however, to alfalfa is that it does not fit in a rotation as well as clover. Potatoes are grown on a small acreage on nearly every farm. A few fields of barley are grown and some barley is sowed mixed with oats.

Wheat is the principal cash crop on farms on this soil. About one-half of the corn produced is sold. Potatoes and similar garden crops are in a majority of cases consumed on the farm. The other crops grown are in most cases fed to stock. There are no important specialized crops produced on this type. In a few places close to the Knox silt loam areas, where the topography is sufficiently rolling to provide good air drainage, there are a few commercial orchards of apples. Apple growing, apparently, could be profitably extended.

The main live-stock industries on this type are the raising of hogs and beef cattle and the feeding of steers. Dairying, sheep feeding, and sheep raising are carried on by only a few farmers.

Corn yields on this type, though they sometimes reach 90 bushels, average between 35 and 45 bushels per acre. Winter wheat yields 20 to 25 bushels per acre, spring wheat 10 to 18 bushels, oats 35 to 40, and occasionally as much as 85, bushels, and barley 20 to 30 bushels. Potatoes occasionally yield 200 bushels per acre. Alfalfa generally affords 3 good cuttings and 1 light cutting, the yield frequently totaling 4 tons per acre. The average yield for the type, however, is probably about 3½ tons per acre.

The soil of the Marshall silt loam is friable and is easily tilled. It is well supplied with organic matter and the type is highly productive. The application of manure and the rotation of crops, including the legumes, seem to be sufficient to restore the organic-matter depleted

by cultivation and to maintain the crop-producing power of the soil. A more or less general rotation is followed on this soil, consisting of corn 2 years or occasionally 3 (in the case of the less progressive farmers 4 or 5 years), oats 1 year, and winter wheat 2 years (or spring wheat 1 year followed by winter wheat), followed either by corn again or by clover and timothy for 2 years. Little or no commercial fertilizer is used on this type.

Land values on this type range from \$120 to \$200 an acre, averaging about \$150 or \$160. Along the Elkhorn Valley prices range from \$100 to \$175 an acre.

Marshall silt loam, flat phase.—The surface soil of the Marshall silt loam, flat phase, is a dark-brown to black, friable silt loam extending to an average depth of 15 inches. The subsoil passes from a brown, heavy silt loam through a silty clay loam into a yellowish-brown silty clay loam which is quite compact. The color becomes lighter and more distinctly yellow with depth. Very faint light-gray mottlings frequently occur. Faint iron stains may appear at any depth in the 3-foot section. Lime in nodular form is generally found below 30 inches. The Kansan drift lies at such a depth beneath the surface that it has no important influence upon the soil. The surface soil is usually well supplied with organic matter, probably having a higher content than any other upland soil.

This phase is developed in small areas or comparatively narrow, elongated strips on the divides between the more important water-courses. The towns of Orum and Spiker are situated on areas of this phase.

The topography of the areas occupied by this phase is, as the name indicates, flat. The land is only fairly well drained. Artificial drainage is beneficial and without it cultivation following rainy periods is delayed.

This phase is not extensive, covering 11.6 square miles. It is important in that it is the most valuable upland soil. Probably 97 per cent of the land is in cultivation or is devoted to pasture, the remainder being occupied by farmsteads and by planted woodlots. The phase, like the typical Marshall silt loam, is naturally a prairie soil.

The principal crops grown are corn, oats, and wheat, these ranking in acreage in the order named. Corn is by far the most important crop. Alfalfa, timothy, and clover are grown to some extent. Winter wheat does exceptionally well, the land never being too wet for this crop. As cropping is much more remunerative than using the land for pasture, and as few farms are composed wholly of land of this phase, very little of it is in pasture. No live-stock industry is developed to an appreciable extent, and no important specialized crops are grown on the phase.

Ordinarily corn yields 40 to 50 bushels per acre, winter wheat 20 to 25 bushels, and oats 35 to 50 bushels. Alfalfa is cut 3 or 4 times, and occasionally 5, and produces as much as 4 to 5 tons of hay per acre per season, though the average yield is about $3\frac{1}{2}$ or 4 tons. Two cuttings are generally obtained from clover and timothy sod, with a total average yield of about 2 tons per acre.

In structure and texture the flat phase is almost, if not quite, identical with the typical Marshall silt loam. The soil is fully as productive, if not more so. The land is easier to till. There are no draws to interrupt cultural operations over large fields, and tractors can be more readily used.

A rather variable crop rotation consisting of corn 1 year, oats 1 year, and wheat 1 year is generally followed by farmers on this soil. Where wheat is not grown corn is generally planted every other year. Occasionally clover and timothy are introduced following oats and allowed to remain 3 years. Little or no commercial fertilizer is used, but barnyard manure is sometimes applied on land to be planted to corn.

The average value of land of the Marshall silt loam, flat phase, is \$175 to \$200 an acre.

The frequent growing of legumes in rotation with the grain crops, the use of barnyard manure, and the plowing under of green vegetation apparently are sufficient to maintain the organic-matter and nitrogen supply of this soil, which would otherwise in time become depleted through the scarcity of live stock on the farms and the tendency to grow cereals exclusively.

WAUKESHA SILT LOAM.

The surface soil of the Waukesha silt loam is a brown to dark-brown, mellow, friable silt loam, extending to an average depth of 16 or 18 inches. In considerable areas along Bell Creek the depth of the surface soil is less than 16 inches. The subsoil is a yellowish-brown, heavy silt loam of very friable structure. The color becomes lighter and more yellowish with depth. At about 20 inches there appear in many places faint gray mottlings and brown iron stains. Lime nodules are sometimes encountered in the subsoil. Except in the greater depth of the Waukesha silt loam surface soil and its tendency to be slightly lighter in color, there is no difference between this type and the Marshall silt loam in the 3-foot section. The underlying loess from which this soil has been derived is of sufficient depth to form a good reservoir for the holding of soil moisture.

The soil mapped as Waukesha silt loam occupying the break or slope between the typical Waukesha silt loam areas and the first bottoms in reality corresponds to the Knox silt loam.

The Waukesha silt loam occurs on terraces, principally along the eastern border of the upland overlooking the Missouri River Valley, and to a limited extent in the Bell Creek and Elkhorn River Valleys. The towns of Herman, Blair, and Fort Calhoun are situated on areas of this type.

The topography is flat to undulating. Drainage is fairly good. In places it has been necessary to cut ditches through the higher land at the outer margin of the terrace in order to afford drainage for the lower lying area adjoining the upland.

The Waukesha silt loam is of relatively small total area. In its larger bodies, however, it constitutes some of the best farming land in the county. The type is in most cases considered too valuable to be used as pasture, and probably 95 per cent of it is in cultivation.

Corn and wheat are the principal crops grown on this type, the acreage of the two being approximately equal. Alfalfa and oats are important crops. Potatoes are grown in a small way. Clover and timothy are very seldom grown. Corn yields 35 to 45 bushels per acre, wheat 15 to 25 bushels, oats 35 to 50 bushels, and alfalfa 3 to 3½ tons of hay.

Rotations practiced on this type are not definite. Some farmers alternate 2 years of corn with 2 years of wheat. A rotation sometimes used is corn 2 to 3 years, wheat 2 to 4 years, and alfalfa for an indefinite number of years, followed by corn. On farms in the vicinity of Blair corn is followed by sweet corn before wheat, to obviate the difficulty encountered in sowing wheat in the cornfield. Commercial fertilizer is not used on this soil, but barnyard manure is applied when available.

The value of land of the Waukesha silt loam ranges from \$125 to \$300 an acre. The average price is between \$175 and \$200 an acre. Values of more than \$200 an acre are restricted to land in the immediate vicinity of Blair and are not due to extraordinary productivity of the soil.

Areas of the type occupying the break or slope between terrace and first bottom are best kept in alfalfa.

SARPY VERY FINE SANDY LOAM.

The surface soil of the Sarpy very fine sandy loam consists of a light-brown or yellowish-brown very fine sandy loam 12 to 16 inches deep. The subsoil is similar to the surface soil, except that it is slightly lighter in color and looser in structure and shows slight gray mottling and faint iron stains. There is no distinct change from surface soil to subsoil.

In small areas southeast of Herman the soil consists of a grayish-brown or light-brown very fine sandy loam to silt loam, 12 inches

deep, underlain by a bluish-gray, plastic, sticky clay, mottled with rusty brown and reddish brown. At 24 to 30 inches the typical very fine sandy loam subsoil is encountered. In a few spots too small to map sandy material is not reached in the lower subsoil within the 3-foot section.

The Sarpy very fine sandy loam occurs in elongated areas in the Missouri and Elkhorn River bottoms, generally near to or adjoining the stream. Owing to the light texture and loose, porous structure of the soil it has good drainage and is easily cultivated. The type is seldom overflowed except in places in the lower lying positions.

This soil is one of the most extensive bottom-land types, and it is an important soil agriculturally. About 65 per cent of the total area is in cultivation and practically all the land is suitable for agricultural use.

The Sarpy very fine sandy loam is largely devoted to the production of corn, which does well if not overflowed. Potatoes are a very successful crop, and some farmers specialize in their production. This soil is admirably suited to onions, watermelons, and cantaloupes. A small acreage of wheat and oats is grown, but the type is not suited to the production of small grains, especially wheat, being too light in texture. Corn ordinarily yields 15 to 30 bushels per acre, though considerably larger yields are sometimes obtained. The stock kept on this type consists principally of hogs. Some attention is paid to the breeding and raising of cattle.

The value of land of the Sarpy very fine sandy loam ranges from \$60 to \$150 an acre. The average price is about \$125 an acre.

Probably the best method of improving soil of this type is the plowing under of vegetable matter to increase the naturally deficient supply of organic matter.

SARPY SILT LOAM.

The surface soil of the Sarpy silt loam is a light-brown to yellowish-brown, rather loose silt loam, somewhat high in percentage of very fine sand. The subsoil is a yellowish-gray, open-structured very fine sandy loam, mottled with light gray and rusty brown. In places the mottling is yellowish brown. This type differs from the Cass silt loam chiefly in its lighter color and slightly higher very fine sand content.

The Sarpy silt loam occurs in the first bottoms of the Missouri River southeast of Herman. It is developed a considerable distance back from the stream. It lies favorably for agricultural use and is well drained.

The total area of this type is 1.5 square miles and it is therefore of little importance. All the land, however, can be used agriculturally, and about 85 per cent of it is under cultivation.

The Sarpy silt loam is a productive soil. It is largely devoted to corn, wheat, and alfalfa. Oats are grown to some extent. Alfalfa does well, making a better growth than on the heavier, less well drained types, and yields about 3½ tons of hay per acre. Corn yields 25 to 40 bushels per acre and wheat 12 to 15 bushels.

Land of this type ranges in value from \$80 to \$160 an acre, with an average selling price of about \$130 an acre.

CASS VERY FINE SANDY LOAM.

The surface soil of the Cass very fine sandy loam, to a depth of about 10 inches, is a very fine sandy loam, dark brown to black when wet and dark brown to grayish brown when dry. The subsoil, into which the surface soil passes almost imperceptibly, is a lighter brown very fine sandy loam, faintly tinged with yellow and gray.

There are included within the areas of this type small patches of a loam, which if it were extensive enough would be mapped as Cass loam. The surface soil here is a dark-brown to black, friable loam, about 14 inches deep. The subsoil is a lighter brown to grayish-brown very fine sandy loam, tinged with yellow. The loam occurs in bottom-land areas where the soils are variable in texture. It is developed in association with the other Cass types, usually with the Cass very fine sandy loam. It is a slightly better agricultural soil than the very fine sandy loam, and less of the land is used for pasture. Corn is practically the only crop grown. It yields 30 to 40 bushels per acre.

The Cass very fine sandy loam is developed in the first bottoms of the Elkhorn River, generally out from the bluff and near the stream. It is closely associated with the Sarpy very fine sandy loam, differing from it mainly in having a darker surface soil. It has a higher organic-matter content and is more productive. The sandy composition of the soil permits good drainage and it is possible to work the ground sooner after a rain than in the case of the Sarpy soil.

The total area of this type is small and it is of little importance in this county. While it is used to some extent for pasture, probably 60 per cent of the type is cultivated. Corn is practically the only crop grown. Yields are ordinarily 25 to 40 bushels per acre. Beef cattle are raised on the farms in a small way and a small number of hogs are pastured. No commercial fertilizer is used.

While there are no farms located wholly upon the Cass very fine sandy loam, its value is about \$70 to \$150 an acre.

CASS SILT LOAM.

The surface soil of the Cass silt loam is a dark-brown to black, heavy, friable silt loam extending to a depth of about 18 inches. The subsoil is a grayish-brown or yellowish-gray very fine sandy

loam, mottled with rusty brown and becoming lighter in color with increase in depth. In a few places the subsoil below 18 inches is a brown, friable, open silt loam, changing at a depth of 22 to 30 inches from the surface to the characteristic very fine sandy loam texture. There are included with this type a few areas of Sarpy silt loam too small to map.

The Cass silt loam occurs in the first bottoms of the Missouri and Elkhorn Rivers, often lying intermediate between the river and the outer margin of the bottoms. The underlying sandy substratum is open and loose and affords good drainage.

The Cass silt loam is not extensive in this county and is relatively unimportant. It is a very productive soil, however, and about 85 to 90 per cent of the total area is in cultivation, the remainder being used for woodlots or building sites or as pasture. All the type is capable of agricultural use.

Corn is the main crop. Considerable wheat is grown, and some oats, as well as alfalfa, which does well. Corn yields ordinarily 30 to 45 bushels per acre, wheat 12 to 20 bushels, oats 35 to 50 bushels, and alfalfa 3 to $3\frac{1}{2}$ tons of hay.

Land values on the Cass silt loam range from \$80 to \$170 an acre, averaging about \$140 an acre.

CASS SILTY CLAY LOAM.

The surface soil of the Cass silty clay loam is a dark-brown to black silty clay loam extending to a depth of 12 to 15 inches. The subsoil is a brownish-gray very fine sandy loam, mottled with rusty brown and light gray. Frequently the subsoil to a depth of 18 to 24 inches is a brown, slightly mottled with light gray, silt loam, from which it passes into the characteristic very fine sandy loam material.

This type occurs in the Missouri River bottoms in scattered areas varying from about 100 to 700 acres in size. Its total extent in this county is very small and the type is of comparatively little importance. The soil is very productive, however, and, with the exception of small lots used for groves or building sites or as pasture land, is all in cultivation, probably between 85 and 90 per cent of the total area of the type being tilled.

The Cass silty clay loam is devoted to the same agricultural uses as the Cass clay. Corn and wheat are the principal crops grown. Both do very well, corn yielding 35 to 45 bushels and wheat 18 to 21 bushels per acre. The soil is handled in the same manner as the other Cass types. No commercial fertilizer is used, but barnyard manure is applied as available.

Land values on this soil type range from \$80 to \$160 an acre, with an average selling price of about \$130 or \$140 an acre.

CASS CLAY.

The surface soil of the Cass clay consists of a dark-brown to black, sticky, plastic clay to silty clay, extending to a depth of about 15 inches. The subsoil is a brown to grayish-brown very fine sandy loam, or in places silt loam, frequently mottled with rusty brown and light gray. Often the upper subsoil is a brownish-drab silty clay, 2 to 10 inches in thickness above the lighter textured material. The surface soil has a granular structure, while the subsoil is open and porous.

Included with the Cass clay is an area, about 600 acres in extent, of Sarpy clay lying east of the Missouri River about 5 miles northeast of Blair. The surface soil here consists of a waxy, plastic silty clay 8 inches deep, yellowish brown to grayish brown in color and sometimes conspicuously mottled with reddish brown. The subsoil continues of the same color with yellowish-brown and light-gray mottlings, and gradually becomes lighter in texture. At about 24 inches a brown very fine sandy loam is usually encountered. The included area of Sarpy clay is low lying, its level being 4 to 6 feet lower than that of the adjoining Sarpy very fine sandy loam. It is subject to frequent overflows and is more or less swampy. The land is used as pasture for cattle and hogs.

The typical Cass clay occurs in a few isolated areas in the Missouri River bottoms. The total area is 3.1 square miles. The soil is productive and, owing to the open nature of the subsoil, well drained, and practically all the type is under cultivation. Wheat and corn are the principal crops. Oats are grown inextensively. Some wild hay is cut. Yields on the Cass clay are practically the same as on the Cass silty clay loam.

Land values on the type range from \$80 to \$150 an acre, with a probable average selling price of about \$130 an acre.

WABASH SILT LOAM.

The surface soil of the Wabash silt loam is a dark-brown to black, heavy silt loam extending to a depth of 15 to 24 inches. The subsoil is a compact, heavy silt loam to silty clay loam, dark brown in color, and sometimes mottled with yellowish brown, rusty brown or gray. It becomes heavier and more dense and compact with depth. The surface soil in the small-stream bottoms is apparently nothing more than recent wash.

The Wabash silt loam occurs in isolated bodies of irregular outline and varying size in the bottoms of the Missouri and Elkhorn Rivers and Bell Creek. It is also mapped in the bottoms of the smaller watercourses throughout the county. The type as a whole is

rather poorly drained, as is evidenced by the conspicuous mottling that occurs in places, especially in the smaller stream bottoms. The type is here subject to overflow, while in the Missouri bottoms and generally along the Elkhorn River and Bell Creek it is not liable to inundation.

The Wabash silt loam is one of the most extensive of the bottom-land types. The areas in the Missouri and Elkhorn River lowlands are almost entirely in cultivation, but the type in the smaller stream bottoms is in few places cultivated, being used here almost exclusively as pasture and hay land. The soil is highly productive and is devoted most generally to grain growing. Corn and wheat and the principal crops, with some hay and oats produced. Corn yields 40 to 50 bushels per acre and wheat 15 to 25 bushels. Alfalfa yields average about 3 tons of hay per acre, but this legume is not grown extensively. The type makes very desirable pasture land, although it is apt to be weedy in wet years.

Stock raising on the farms is not of any definite type. The stock pastured are generally work horses and mules, colts, beef cattle and milch cows, and hogs. Barnyard manure is applied as the supply becomes available, and no commercial fertilizer is used.

Land values on the Wabash silt loam range from about \$80 to \$180 an acre. In the small-stream valleys no farm is made up of land of this type alone. In the Missouri River, Elkhorn River, and Bell Creek bottoms the average price of the land is between \$150 and \$180 an acre.

It is advisable to keep sodded that part of the type that is subject to overflows. Even grass land is subject to injury from water-deposited material.

WABASH SILTY CLAY LOAM.

The surface soil of the Wabash silty clay loam, to a depth of about 15 inches, is a dark-brown, dark-drab or frequently deep-black, silty clay loam. The subsoil is a dark-brown, brown mottled with bluish gray or a rusty-brown silty clay loam to clay loam. It becomes heavier with increase in depth. In the Bell Creek bottoms it is generally a black, dense, plastic silty clay loam to silty clay. In places the subsoil is darker than the surface soil, the immediate surface soil here consisting of recent wash. The type differs from the Cass silty clay loam in having a heavy subsoil.

The Wabash silty clay loam is not extensive. It occurs in numerous areas throughout the extent of the Missouri River bottoms. It also comprises the greater part of the Bell Creek first bottoms. The areas in the Missouri lowlands are fairly well drained, but along Bell Creek the type is generally poorly drained, and in rainy periods it is in a swampy condition.

About 80 per cent of that part of the type in the Missouri River bottoms is in cultivation, with the remainder largely in pasture. Practically all the land here is arable. The agricultural practices are in general the same as those on the Wabash silt loam in the Missouri bottoms. Corn ordinarily yields 40 to 50 bushels per acre and wheat 18 to 25 bushels. The average yield of land of the type here is about \$140 an acre.

The areas of Wabash silty clay loam in the Bell Creek bottoms are utilized mainly as wild hay and pasture land. Corn is grown to a small extent away from the stream, but in the main the type is subject to frequent overflows at any time of the year. It is possible that dredging and straightening the stream channel might enable some of the land nearer the creek to be put in cultivation, but wild grasses afford such a good cutting of hay that at present there is no disposition on the part of the landowners toward undertaking reclamation in this way. Wild grasses make a very rank growth and yield about $1\frac{3}{4}$ tons of hay per acre. No farms in the Bell Creek Valley occur wholly on this type, but land prices average about \$70 an acre.

WABASH CLAY.

The surface soil of the Wabash clay is a dark-brown, dark-drab or black, plastic, waxy, silty clay to clay, extending to a depth of about 12 inches. This is underlain by a heavy, plastic clay, dark brown in color or dark brown mottled with rusty brown, yellowish drab or drab. The mottlings are not sharply distinct from the basic color. At a depth of 30 inches lime concretions are generally encountered. The soil has a granular structure.

This type occurs in the Missouri River bottoms. The principal development is east and southeast of Herman, in which locality there is a large continuous area comprising several thousand acres.

With the exception of draws and low-lying areas, the Wabash clay is not subject to inundation from the flood waters of the Missouri River. Part of the type, however, that lies along the straightened channel of Fish Creek is flooded in wet seasons to such an extent that it is impossible to grow crops. This is due to the fact that drainage water from Burt County is conducted to the north boundary of Washington County in a ditch very much larger than the continuing ditched creek channel in this county and in periods of excessive rainfall the smaller ditch can not carry all the water it receives.

The Wabash clay is among the most important of the alluvial soils. Some of the land is devoted to pasture for cattle, hogs, and horses, but perhaps 75 per cent of the total area is in cultivation. Wheat and corn are the principal crops, being grown on approxi-

mately equal acreages. Considerable wild hay is cut, but new land is broken for cultivation each year. Only a very small acreage is in oats, as the crop grows too rank on this type. Little alfalfa is grown. This crop does fairly well in dry years, but it is not as successful as on the uplands. Crops in general do not do well in wet years. Wheat yields 20 to 25 bushels per acre, corn 40 to 50 bushels, and oats 30 to 50 bushels. Wild hay yields 1 ton to 1 $\frac{1}{4}$ tons per acre.

No definite crop rotation is practiced on this type, it being customary to keep the land in the same crop for 5 to 8 years or even longer. The land is usually plowed in the fall, as soon as the wheat is harvested. The soil is hard to handle, forming clods if plowed when too wet. It is locally known as "gumbo."

A large proportion of the farms on this type are leased by tenants. Cash rental is generally \$5 an acre. Usually the lease is on the share basis, the tenant furnishing the seed and necessary equipment and receiving one-half the crop.

Land of this type ranges in price from \$100 to \$130 an acre, the average probably being nearer the higher than the lower figure.

RIVERWASH.

The term Riverwash is applied to the recent alluvium, consisting of a heterogeneous deposit of sandy loams, sands, and silt, constituting river bars and levees along the Missouri River.

The greater part of this type occurs along the Missouri River. The areas shown on the map are low in position, usually lying only a few feet above the normal level of the river. They are either barren or have a growth of willows.

Riverwash is generally not a permanent soil. It is inundated when the river reaches its higher stages, and the material changes with each overflow. Even when the river is at normal stage the material is washed away in places, to be deposited somewhere else. It is also considerably modified by wind action. Along the Missouri River the material drifts easily and on windy days forms dust clouds. None of the type is of agricultural value at present.

SUMMARY.

Washington County is situated on the central eastern border of Nebraska, being separated from the State of Iowa by the Missouri River. It comprises an area of 380 square miles, or 243,200 acres.

Physiographically, the county is an old loessial plain, now dissected by dendritic drainage systems. It may be divided into two main topographic divisions, the uplands and the lowlands. Most of the upland consists of undulating to broken land developed by ero-

sion from the old loessial plain. The lowlands consist mainly of first bottoms or alluvial flood plains, but also include flat to undulating terraces or second bottoms. The elevation of the county above sea level ranges from 1,000 to 1,320 feet. The surface drainage is everywhere good.

The county has a population of 12,738, of which number about 80 per cent is classed as rural. The principal towns are Blair, Arlington, Herman, Fort Calhoun, and Kennard. Four lines of railroad serve the county, and all localities are fairly well supplied with transportation facilities. The public roads are systematically improved. Schools and churches are established in convenient locations. Omaha constitutes the principal market for the agricultural products, with the exception of fruit, which is shipped to western and northern markets.

The climate of Washington County is healthful. The mean annual precipitation is 32 inches. The average growing season, or the period between the last killing frost in the spring and the first in the fall, is 157 days in length and is ample for the maturing of all the ordinary farm crops.

Agriculture in Washington County consists of the production (for sale, feeding, and home consumption) of the general farm crops of corn, oats, hay, wheat, barley, and potatoes, combined with dairying, hog raising, cattle feeding and raising, and fruit growing. Nearly all the farms are well improved and the equipment is modern and efficient. The work stock consists of medium to heavy draft horses and mules.

Only a rather indefinite system of crop rotation, subject to numerous substitutions, is practiced. Little commercial fertilizer is used, but the manure produced is saved and applied to the land. Farm labor, while not plentiful, is obtainable at reasonable wages. The size of farms ranges from 25 to more than 600 acres, most of them ranging between 80 and 320 acres. Farm land sells for \$40 to \$200 an acre.

The soils of the county are glacial, loessial, and alluvial. The glacial soil is derived from Kansan drift and has been correlated as the Shelby silt loam. The loessial soils consist of the Knox, Marshall, and Waukesha silt loams, the latter being of terrace development. The alluvial soils are derived from material deposited as first bottom by the various watercourses that lie within or border the county, and are recognized as of the Cass, Sarpy, and Wabash series.

The Marshall silt loam of the upland is the most extensive and important soil in Washington County. While well adapted to small grains, hay, alfalfa, and potatoes, it is preeminently suited to corn,

being one of the best corn soils in the United States. The Knox silt loam, owing to its favorable topography as well as to the nature of the soil, is especially suited to the growing of fruits. The alluvial lands along the small streams are well suited to hay and pasture purposes. The Wabash and Cass types are good corn soils.

The soils of Washington County are as productive as are to be found in the State, and soil conditions as well as other factors are favorable to dairying, fruit growing, and general farming.



[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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